CLAIMS

1. A porous semiconductor, comprising:
a porous substrate having continuous pores; and
a porous semiconductor layer having a light emitting function that works by electroluminescence, cathode luminescence, or photoluminescence, and having continuous pores.

2. A porous semiconductor according to Claim 1, which emits ultraviolet light with a wavelength of 400 nm or less.

3. A porous semiconductor according to Claim 2, wherein the ultraviolet light has a wavelength of 200 to 400 nm.

4. A porous semiconductor according to Claim 3, wherein the ultraviolet light has a wavelength of 230 to 270 nm.

5. A porous semiconductor according to any of Claims 1 to 4, wherein the semiconductor layer has a pn junction structure.

6. A porous semiconductor according to any of Claims 1 to 5, wherein a porosity of the semiconductor layer is at least 30%.

7. A porous semiconductor according to any of Claims 1 to 6, wherein an average pore size of the porous substrate and/or the porous semiconductor layer is from 0.0003 to 100 μm.

8. A porous semiconductor according to any of Claims 1 to 7, wherein an insulating layer is formed on the front and/or back surface of the semiconductor layer.

9. A porous semiconductor according to any of Claims 1 to 8, wherein the insulating layer is formed from a material having a photocatalytic function.

10. A porous semiconductor according to any of Claims 1 to 9, wherein the semiconductor layer is made up of crystal particles, and a surface of these crystal particles is coated with particles having a photocatalytic function.

11. A filter composed of the porous semiconductor according to any of Claims 1 to 10.

12. A filter according to Claim 11, wherein the porous substrate is a porous ceramic or a metal having continuous pores, and a porous semiconductor layer is provided in an interior or on a surface of the substrate.

13. A filter according to Claim 12, wherein a porosity of the porous substrate is at least 30%.

14. A filter according to Claim 12 or 13, wherein a thickness of the porous semiconductor layer disposed on the surface of the porous substrate is from 1 to 1000 μm.

15. A filter according to any of Claims 12 to 14, wherein an average pore size of the porous substrate is from 0.01 to 1000 μm.

16. A porous semiconductor according to any of Claims 1 to 9, wherein the porous semiconductor layer is composed

of numerous columns of semiconductor material erected on a surface of the porous substrate.

17. A porous semiconductor according to Claim 16, wherein the pores in the porous substrate are through-holes perpendicular to a substrate plane.

18. A porous semiconductor according to Claim 16 or 17, wherein an average pore size of the porous substrate is from 0.1 to 100 μm.

19. A porous semiconductor according to any of Claims 16 to 18, wherein a pn junction is formed in a lengthwise direction of the columns.

20. A porous semiconductor according to any of Claims 16 to 20, wherein the columns comprising a base component and a pointed component located on the distal end side of this base component.

21. A porous semiconductor according to any of Claims 16 to 20, wherein an electroconductive porous film is disposed as an electrode at the distal ends of the columns and on an opposite surface of the porous substrate from the surface where the columns are formed.

22. A porous semiconductor according to any of Claims 16 to 21, wherein an electroconductive porous film is disposed as one electrode at the distal ends of the columns, and the porous substrate is composed of an electroconductive material and constitutes another electrode.

23. A porous semiconductor according to Claim 22 or

23, wherein a surface of the columns and/or a column-side surface of the electrode disposed at the distal ends of the columns is coated with particles having a photocatalytic function.

24. A filter that makes use of the porous semiconductor according to any of Claims 15 to 24.

25. A porous semiconductor according to any of Claims 1 to 10, wherein the porous semiconductor layer is formed by depositing semiconductor particles having a light emitting function on a surface of the porous substrate.

26. A porous semiconductor according to Claim 25, comprising an electrode for injecting current into the porous semiconductor layer.

27. A porous semiconductor according to Claim 25 or 26, wherein the porous semiconductor layer is composed of a deposited layer of p-type semiconductor particles and a deposited layer of n-type semiconductor particles to form a pn junction.

28. A porous semiconductor according to any of Claims 25 to 27, wherein a surface of the semiconductor particles is coated with an insulating layer.

29. A method for manufacturing a porous semiconductor having a light emitting function and composed of a porous substrate having through-holes, and a porous semiconductor layer formed on a surface of this substrate, the method comprising at least steps of:

(a) preparing a porous substrate and at least one of semiconductor particles having a light emitting function

that works by electroluminescence, cathode luminescence, or photoluminescence;

(b) producing a suspension of the semiconductor particles; and

(c) filtering the suspension through the porous substrate and forming a deposited layer composed of semiconductor particles on the surface of the porous substrate.

30. A method for manufacturing a porous semiconductor according to Claim 29, further comprising a step of forming an electrode for injecting current into the deposited layer.

31. A method for manufacturing a porous semiconductor according to Claim 29 or 30, further comprising a step of performing a treatment for bonding together the individual semiconductor particles that form the deposited layer, after the step (c).

32. A method for manufacturing a porous semiconductor according to Claim 31, wherein the treatment is a heat treatment.

33. A method for manufacturing a porous semiconductor according to Claim 31, wherein the treatment is a treatment in which a semiconductor material is deposited in the vapor phase at the contact portions between the semiconductor particles.

34. A method for manufacturing a porous semiconductor according to any of Claims 29 to 33, comprising a step of coating a surface of the semiconductor particles with an insulating layer or a material having a photocatalytic function, between the steps (a) and (b).

35. A method for manufacturing a porous semiconductor according to any of Claims 29 to 34, wherein a step of coating a porous substrate surface with an insulating layer is added before the step (c), and a step of coating the surface of the deposited layer with an insulating layer is added after the step (c).

36. A method for manufacturing a porous semiconductor according to any of Claims 29 to 35, wherein in the step (b), at least one of suspension of p-type semiconductor particles and at least one of suspension of n-type semiconductor particles are prepared, and in the step (c), these suspensions are alternately filtered through the porous substrate to form a deposited layer with a pn junction structure.

37. A method for manufacturing a porous semiconductor according to any of Claims 29 to 36, wherein an average size of the semiconductor particles is from 0.01 to 5 μm.

38. A filter composed of the porous semiconductor according to any of Claims 25 to 28.

39. A porous semiconductor according to any of Claims 1 to 7, wherein an electrode is formed on a top or bottom surface of the porous substrate, a porous insulating layer, a porous semiconductor layer, and a porous insulating layer are laminated on the porous substrate, another electrode is formed on a top surface, the porous semiconductor layer emits ultraviolet light by electroluminescence when AC voltage is applied between the electrodes, and the porous semiconductor has a bandgap of at least 3.2 eV and is doped with gadolinium, which is the light emitting center.

40. A porous semiconductor according to any of Claims 1 to 7, wherein an electrode is formed on a top or bottom surface of the porous substrate, the porous semiconductor layer is formed by dispersing semiconductor particles in an insulating layer, an electrode is formed on the porous semiconductor layer, the porous semiconductor layer emits ultraviolet light by electroluminescence when AC voltage is applied between the electrodes, and the semiconductor particles have a bandgap of at least 3.2 eV and are doped with gadolinium, which is the light emitting center.

41. A porous semiconductor according to Claim 39 or 40, wherein a surface of the porous insulating layer or of the porous semiconductor layer formed by dispersing semiconductor particles in the insulating layer is covered by a porous layer having a photocatalytic function, or pore walls of the porous substrate are covered by a material having a photocatalytic function.

42. A porous semiconductor according to Claim 39 or 41, wherein the porous insulating layer or the insulating layer in which the semiconductor particles are dispersed is formed from a material having a photocatalytic function.

43. A porous semiconductor according to any of Claims 39 to 42, wherein the bandgap of the porous semiconductor layer or the semiconductor particles is at least 4.0 eV.

44. A porous semiconductor according to any of Claims 39 to 43, wherein either the electrodes are porous or the structure of the electrodes has a porous structure.

45. A porous semiconductor according to Claim 44,

wherein the electrodes are composed of a porous transparent electroconductive film.

46. A method for manufacturing a porous semiconductor in which a porous insulating layer, a porous semiconductor layer, and a porous insulating layer are laminated on a porous substrate having continuous pores and having an electrode formed on its top or bottom surface, and another electrode is formed on the top surface, the porous semiconductor emitting ultraviolet light by electroluminescence when AC voltage is applied between the electrodes, the method comprising at least steps of:

(a) preparing a suspension of gadolinium-doped semiconductor powder and a suspension of a insulator powder;

(b) filtering the suspension of a insulator powder through the porous substrate to deposit a porous insulating layer on the porous substrate surface;

(c) filtering the suspension of the semiconductor powder through the porous substrate to deposit a porous semiconductor layer on the insulating layer; and

(d) further filtering the suspension of the insulator powder through the porous substrate to deposit a porous insulating layer on the semiconductor layer.

47. A method for manufacturing a porous semiconductor in which a porous semiconductor layer comprising semiconductor particles dispersed in an insulating layer is formed on a porous substrate having continuous pores and having an electrode formed on its top or bottom surface, and another electrode is formed on the top surface, the porous semiconductor emitting ultraviolet light by electroluminescence when AC voltage is applied between the electrodes, the method comprising at least steps of:

(a) preparing a gadolinium-doped semiconductor powder;

(b) covering the semiconductor powder with an insulating layer and preparing another suspension thereof; and

(c) filtering the suspension through the porous substrate to deposit a porous semiconductor layer on the porous substrate.

48. A filter composed of the porous semiconductor according to any of Claims 39 to 45.

49. A bioreactor composed of the porous semiconductor according to any of Claims 39 to 45.

50. An ultraviolet light source that makes use of the porous semiconductor according to any of Claims 39 to 45.

51. A porous semiconductor according to any of Claims 1 to 9, wherein the porous semiconductor layer is made of porous silicon nitride composed of columnar Si_3N_4 particles with an average aspect ratio of at least 3 and an oxide-based binder phase containing at least one of rare earth element, and emits visible light or ultraviolet light.

52. A porous semiconductor according to Claim 51, wherein a surface of the columnar Si_3N_4 particles is covered with a film or particles having a photocatalytic function.

53. A porous semiconductor according to Claim 51, wherein a film or deposited layer of particles having a photocatalytic function is formed on a surface of the porous semiconductor layer.

54. A porous semiconductor according to any of Claims 51 to 53, which emits ultraviolet light having its peak wavelength at 300 to 320 nm.

55. A porous semiconductor according to any of Claims 51 to 54, containing at least gadolinium as the rare earth element.

56. A porous semiconductor according to Claim 55, further containing yttrium as the rare earth element.

57. A porous semiconductor according to any of Claims 51 to 56, wherein an average pore size of the porous semiconductor layer is from 0.1 to 5 μm.

58. A porous semiconductor according to any of Claims 51 to 57, wherein a three-point bending strength is at least 100 MPa.

59. A light emitting device having the porous semiconductor according to any of Claims 51 to 58.

60. A filter that makes use of the porous semiconductor according to any of Claims 51 to 58.

61. A porous semiconductor according to Claim 1, wherein the porous substrate is columnar in shape and has formed therein in an axial direction a plurality of holes serving as passages for a fluid to be treated, the continuous pores lead from an inner wall of the holes to a side of the column, and the porous semiconductor layer is formed on the inner wall.

62. A porous semiconductor according to Claim 1,

wherein the porous substrate is a honeycomb structure, in the honeycomb structure are formed an inflow-side honeycomb passage and an outflow-side honeycomb passage separated by a partition, the continuous pores are formed inside the partition, and the porous semiconductor layer is formed on the inner walls of the inflow-side honeycomb passage.